

DOCUMENT RESUME

ED 229 272

SE 041 554

AUTHOR Miller-Souviney, Barbara
TITLE Teaching Community School Mathematics - A Comparison of Five Sites. Indigenous Mathematics Project. Working Paper 18.
INSTITUTION Indigenous Mathematics Project, Port Moresby (Papua New Guinea).
SPONS AGENCY Papua New Guinea, Dept. of Education, Port Moresby.; United Nations Educational, Scientific, and Cultural Organization, Paris (France).
PUB DATE Jun 81
NOTE 46p.; For related documents, see SE 041 540-555.
PUB TYPE Reports - Descriptive (141) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Cross Cultural Studies; Cultural Influences; Curriculum Development; Educational Research; Elementary Education; *Elementary School Mathematics; Ethnography; *Field Studies; Inservice Teacher Education; *Mathematics Curriculum; *Mathematics Instruction; Teaching Methods
IDENTIFIERS *Indigenous Mathematics Project; Mathematics Education Research; *Papua New Guinea

ABSTRACT

This report summarizes the classroom events associated with the implementation of trial mathematics curriculum materials at five community schools in Papua New Guinea. The field-notes prepared by classroom observers during the study of the Indigenous Mathematics Project formed the data base. Lessons implemented in at least four of the five sites were selected for summarization: 12 lessons in grade 2, 13 in grade 4, and 14 in grade 6, out of a total of 82 lessons implemented. Questions, problems, and suggested solutions are listed for each lesson, with the source site designated. Conclusions and recommendations are offered in the final section. Explicit comments on classroom management are given in relation to materials management, activity books, lesson organization, classroom atmosphere, and evaluating student progress. In regard to instructional materials, comments are included on teacher's notes, background notes, lesson introduction, answers, alternative materials, review lessons, and a teacher in-service course. A comment on the value of in-service training concludes the report. (MNS)

* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *

ED229272

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

✓ This document has been reproduced as
received from the person or organization
originating it.

☐ Minor changes have been made to improve
reproduction quality.

• Points of view or opinions stated in this docu-
ment do not necessarily represent official NIE
position or policy.



"PERMISSION TO REPRODUCE THIS
MATERIAL HAS BEEN GRANTED BY

Randall Souniney

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)."

INDIGENOUS MATHEMATICS PROJECT

SE041554

**TEACHING COMMUNITY SCHOOL
MATHEMATICS — A COMPARISON
OF FIVE SITES**

Barbara Miller-Souviney

Working Paper 18
June 1981

THE INDIGENOUS MATHEMATICS PROJECT

This series of working papers and research reports has been published to provide a comprehensive source of documentation on research and development efforts associated with the Indigenous Mathematics Project. The Project was established in 1977 by the Government of Papua New Guinea to investigate various aspects of traditional mathematics development. During the first phase (1977-79) of the five year program, basic research in crosscultural cognitive development was carried out and indigenous counting, classification and measurement systems used throughout the country were documented. During the second phase of the project (jointly funded by the Department of Education and UNESCO), pilot instructional materials were developed and trialled. The intent was to assess the feasibility of utilizing complementary aspects of indigenous and Western mathematics as a basis for developing culturally relevant student materials, instructional aids and teachers' guides which reflect the practical constraints of the community school environment. The results of IMP work are intended to inform future curriculum development in an effort to provide more appropriate instructional materials and learning aids for Community Schools throughout Papua New Guinea.

Series Editor: Randall Souviney
Managing Editor: Jacquie Wathen

TEACHING COMMUNITY SCHOOL MATHEMATICS -
A COMPARISON OF FIVE SITES

Barbara Miller-Souviney
June 1981

This report summarizes the classroom events associated with the implementation of trial mathematics curriculum materials at five community schools in Papua New Guinea. The author used as a data base, detailed field-notes prepared by M. Gearhart, K. Johnson, P. Levin, J. Lineberger and R. Rowe who served as classroom observers during the Indigenous Mathematics Project sponsored study.

TEACHING COMMUNITY SCHOOL MATHEMATICS -
A COMPARISON OF FIVE SITES

The following section summarizes detailed observations made during the implementation of trial mathematics curriculum materials at the five IMP sites (Gearhart, 1980; Johnson, 1980; Levin, 1980; Lineberger, 1980; Rowe, 1980). Lessons implemented at at least four of the five sites were selected for summarization. Thirty-nine lessons (12 grade two; 13 grade four; and 14 grade six) out of a total of 82 implemented were included in the sample.

A form was developed for use by the reviewer to standardize the documentation procedures (see Appendix I). Summary categories included:

1. Lesson number
2. Lesson objective
3. Pre-interview questions
4. Debriefing suggestions
5. Evaluation of the instructional materials
6. Evaluation of the teaching methodology and management
7. Time required for the lesson

Data was extracted from the field-notes and entered in the appropriate column on the form under each site. An overall narrative summary was subsequently prepared under the headings:

1. Questions - Pre-interview queries offered by the teacher.
2. Problems - Difficulties encountered at one or more sites relative to time, instructional materials, teaching methodology and/or classroom management.
3. Solutions - Suggestions made by the teacher and/or observer as to how to improve the instructional materials, teaching methodology and/or classroom management.

Wherever possible the origin of a question or suggestion is indicated by the sites provincial initials (MP, WSP, SHP, WHP, NCD). If a

recommendation was unanimous it is followed by the word (All). Comments (except pre-interview questions) made by teachers are indicated by the phrase "One teacher suggested ...", followed by the provincial initials. The results are presented by grade level - followed by an overall summary and conclusions.

Several different types of curriculum materials are referred to throughout the report. Teacher's Notes were prepared for grades two and four giving lesson objectives, materials, step-by-step instructions and a copy of the student activity sheets. For grade six the teacher received a copy of the student textbooklet. Each student received a set of activity sheets, one for each lesson. A minimal set of learning aids were also provided for each child (base-10 materials, play coins, Kina attribute cards, squared-paper exercise books and measurement devices).

GRADE TWO LESSON SUMMARIES

LESSON - 2:53 A - Counting to 20

Questions

1. What if a 5 appears on the dice? (WHP)
2. Why are we using a die marked 0 to 5 when we're working in base-3? (WHP)
3. Where will we get the leaves? (WHP)
4. Are 53A and B the same lesson? (SHP)

Problems

1. No lap boards to write on. (NCD)
2. No workbooks given to children. (NCD)
3. Teachers had to move about the room very often to help students. (All).
4. Too much material to cover in one lesson. (All)
5. No whole group demonstrations were done before breaking into groups. (WSP, NCD)
6. The objective of the lesson was not met because it required too much abstract thought for students. (All)

Solutions

1. The teachers should engage in whole class demonstrations before breaking into groups. (SHP, WHP)
2. Provide more detailed directions for the teachers to minimise errors in interpreting the lesson. (SHP, WHP)
3. The lesson should be broken into three or more lessons so that the children will have ample time to understand the concepts and the game. (SHP, NHP)
4. The materials did not provide for direct comparison when exchanging "3 for 1 leaf". Money or base-10 materials might be more useful. (SHP)

LESSON - 2:53 C - Changing 10 for 1

Questions

None.

Problems

1. It took too much time to record answers on both the chalkboards and exercise books. (SHP and WHP suggested avoiding the use of both chalkboard and exercise books at the same time.)
2. Concrete materials were not used before representational phase of the lesson. (WSP) To avoid confusion, the students need to "explore" the materials first. (SHP, WSP)
3. The lesson took longer than suggested. (WSP - four periods, SHP - SHP - two periods, NCD - two periods.)
4. Students working on their own became confused. (WSP, NCD)

Solutions

1. Use either a chalkboard or exercise book to record exercises, not both.
2. Allow time for the students to make direct comparisons using concrete materials before recording on their lapboards.
3. Have students work in small groups with a leader in each to help those students having trouble.
4. Provide follow-up exercises for the students after the initial demonstration.

LESSON - 2:53 D - Numbers to 20:Place-value

Questions

1. How do you play the game? (WSP)

Problems

1. The teacher explained the game to the group leaders only. The other students were confused. (WSP)
2. The teachers explained the lesson without the children looking at the place-value table in the workbook (no visual aids). (NCD)
3. The teacher took too much time to pass out the materials. (All)
4. The lesson required two periods. (WSP, NCD)
5. Not enough lapboards for each student. (SHP)
6. The teacher explained the lesson with three children using only one board. (WSP)
7. The students took too much time to record their results in their exercise books while playing the game. (WHP)

Solutions

1. The teacher should explain the lesson to the whole class first, using the activity book and base-10 materials.
2. Have the group leaders pass out all the materials beforehand. One teacher suggested making a schedule chart for the whole school so that the materials could be used by everyone without conflict. (NCD)
3. If there are not enough lapboards for each child, use desk tops or divide one board in half for two students. (WHP)
4. While one teacher suggested writing the place-value tables in the exercise book along with the symbols (SHP), another felt recording in both the exercise book and on the lapboard took too much time. He recommended using the lapboards only. (WHP)
5. The teacher should introduce reinforcement activities (additional problems) after the game is played. (WHP)
6. To keep the materials organized, have containers or envelopes available in which to store the base-10 materials. This will help keep the teacher, students and classroom organized.
7. Use an additional die with a (+) on it so children will know what to do with the two numbers. (WHP)

LESSON - 2:53 E - Numbers to 20 Using Money

Questions

None.

Problems

1. The lesson took too long and had to go to second day because the dice were not used during the explanation of the game. (WSP)
2. The teacher did not use the place-value table when explaining the activity. (NCD)
3. The teacher had to move around too much to oversee games. (WHP)

Solutions

1. Pass out materials beforehand - always provide concrete materials (dice, etc.) when required.
2. One teacher suggested setting up a permanent table to store base-10 materials and other aids where students having trouble can go and work with the teachers. Others could go on unsupervised. (WHP)
3. During the lesson introduction have an inner circle play the game and an outer circle observe. This arrangement would reduce the need for the teacher to move about the room excessively during the whole-group explanation stage.
4. Teacher's Notes should be organized so that the overall sequence of the lessons is apparent (eg. logical sequence from place-value to addition). A content/methodology section included before each new topic would help orient the teacher to the overall sequence of objectives. (WSP) Cross referencing between lessons dealing with the same concept later in the year was also suggested. (WSP)
5. Two teachers felt this was the best lesson so far. They felt practice using money was motivating and a valuable real world concern for children. (SHP, WHP)

LESSON - 2:53 F - Counting to 20

Questions

1. What is this drawing (of stick figures) on page 11? (SHP)

Problems

1. The lesson took two days to complete. The children had trouble turning left and right. (WSP)
2. Some children had trouble counting by twos. (NCD)

3. Some students had difficulty "drawing what they did outside" without teacher guidance. One teacher marked the children's drawings for accuracy. (SHP)

Solutions

1. For students who had trouble counting by twos, the lesson was at the right level of difficulty. However at three sites (WSP, SHP, WHP) children had no difficulty counting and the teachers took the opportunity to challenge able students with harder problems (eg. count to 20, 25, then 30, count backwards, count the "easy way" (by twos) and "get into groups of four - pass a ball around five times".)
2. Teachers should provide initial assistance with the students' drawings by discussing what happened outside. Children should be encouraged to use their creativity when drawing.
3. Teachers checking and marking drawings seemed inappropriate. However, ongoing student evaluation should be encouraged where specific skills are being developed. (SHP)

LESSON - 2:53 G - Counting Sets: 1-20

Questions

None.

Problems

1. Instructions in the Teacher's Notes confused two teachers because numbered instructions didn't coincide with exercise numbers in the student workbook. (WSP, SHP)
2. One problem stated "Count the pumpkins". The picture is of coconuts.
3. One teacher seemed unaware that he had the student activity pages in the Teacher's Notes. (NCD)
4. Students are not numbering their problems in their exercise books. Student answers were not separated from the exercise numbers at one school which caused a good deal of confusion (eg. 118 should be 1. 18). (SHP)
5. Some pictures were unfamiliar to non-coastal students. (SHP, WHP)
6. The picture of a hand, writing in an exercise book, at the bottom of the activity sheet was ineffective. The teacher should be instructed that when they see the hand, the students are supposed to record their answers in their exercise books. (WHP)

Solutions

1. Instruct the teachers to look at student's activity pages when giving instructions to students to avoid confusion. Also, teachers should not read aloud the instruction numbers in the Teacher's Notes.
2. Clearly state to teachers that the Teacher's Notes contain the student activity sheets.
3. Instruct the students to number their books before they start their exercises and to draw a vertical line after the problem numbers to separate them from their answers.
4. The teachers should discuss the worksheet with students before the lesson begins. Include pictures of peanuts, pigs, chickens and trucks for highlands children. (SHP)
5. Teachers should tell the children to record their answers in their exercise books whenever they see the "hand". (WHP)
6. Teachers at three sites reviewed the previous lesson (counting to 20) and conducted evaluation during the lesson. Both should be suggested in the Teacher's Notes. (SHP, WHP, NCD)

LESSON - 2:53 I - Addition Facts to 10

Questions

None.

Problems

1. All sites felt the lesson covered too much for one period.
2. Several teachers took too long to pass out the materials. (WSP, SHP, NCD)
3. The idea of place-value exchange was not explained to children as part of the lesson. (SHP, WHP, NCD)
4. One teacher had the students put the base-10 materials in the place-value table on the activity sheet. The boxes were too small making it awkward for the students. (WSP)
5. The same teacher omitted the representational level of the lesson as well. He focused on the answer not the process. He used the base-10 materials superficially, focusing instead on the symbolical answer. The teacher had the students use only their activity sheets instead of their lapboards and passed out the base-10 materials after the explanations, stressing writing the answer "quickly". (WSP)
6. At two sites no reference was made to the activity-sheet pictures. (NCD, SHP)

Solutions

1. The activity should be divided into two lessons. Teach addition with sums less than 10 first and then introduce regrouping.
2. Specific instructions should be provided in the Teacher's Notes regarding classroom management and material distribution.
3. The teacher should demonstrate manipulative procedures to the entire class on the chalkboard. Using a teacher prepared place-value tables worksheet would encourage students to concentrate on filling in the appropriate information. (WHP)
4. Manipulating the base-10 materials during whole-group demonstrations as well as individual activities must be stressed in the Teacher's Notes to help teachers understand the importance of concept development.

LESSON - 2:55 A - Ordering Time

Questions

None.

Problems

1. The lesson took too long at all sites.
2. Glue, scissors and even paper were scarce and, when available, took long to pass out.
3. The children were not able to draw, cut and paste the pictures in the time allowed.
4. Recording the order of "finishers" in the race was confusing. (WSP, WHP, NCD)
5. One teacher had trouble distinguishing between actions (run, walk, crawl, hop, walk backwards). Consequently, the students were confused. (SHP)
6. One teacher had the students merely imitate the actions, without actually "racing". The order of finishers was obviously confusing. (NCD)
7. One teacher had the students record who came in first only. (WSP)

Solutions

1. Have the pictures of the contestants drawn and cut out before the race (the teacher at WHP suggested making them during an art lesson).
2. Have students simply draw the time-line and write the names of the finishers (run, hop, walk, etc.) in the proper order. (WHP)

3. Have the students perform each action prior to the race. (SHP)
One teacher suggested lining up the finishers after the race in single file in the correct order so the time-line can be completed more easily. Do this for each group of five. (WHP)
4. Have only one group race while the other students watch. Stress the order of finishers. Have the students predict the order before the race.
5. Label the racers with headbands inscribed with the appropriate action. (WSP)
6. After the race give the finishers two "new names" (eg. run, 1st). It is easier to transfer the information to time-line. (WHP)

LESSON - 2:55 B - Ordering Age

Questions

1. Can I use youngest, younger, young, oldest, older, old? (WHP)

Problems

1. Teachers had difficulty explaining the terms "youngest" and "oldest" in English. (WHP, SHP, WHP)
2. Lesson included too many parts to be co-ordinated by grade two children. (All)
3. Some children had difficulty copying the time-line. (WHP, NCD)
4. Some students found it difficult to recognise the pictures. The sexes were unequally represented in the graphics. (SHP)

Solutions

1. Teachers should be encouraged to use Pidgin or tok ples when explaining difficult terms to students.
2. Have three, four and then five children line up in order from youngest to oldest before presenting the activity sheets. It may be necessary to use a few children from older classes. (WHP)
3. Split this activity into two or more lessons - one to prepare the pictures and one to create a time-line. A discussion about the stages of growth for boys and girls might follow. (SHP)
4. The Teacher's Notes should include a procedure for drawing a time-line of a specified length. (Children and teachers confused points with line segments - eg. five points instead of five spaces.) One teacher had his students count spaces (5) between vertical lines in their exercise books. (WHP)
5. Use all the same sex or more than one female in the pictures. The one female seemed to confuse many students. (SHP)

LESSON - 2:56 A - Ordering Groups of Things (Sets)

Questions

None.

Problems

1. The terms "smallest" and "largest group of things", were confusing. Teachers felt students confused the size of the objects with the size of the sets. (WSP, SHP, WHP)
2. Copying pictures of sets takes too long. (WHP, WSP)
3. Too many steps were required for this activity (drawing, counting, marking sets and recording answers). (WSP)

Solutions

1. Change the comparative terms to "fewest" and "most".
2. Instead of pictures of pigs, use something closer in size to other objects. (SHP)
3. Do this lesson orally as an introductory activity for a lesson on sets and ordering. (SHP) Teacher's Notes should include introductory examples. (WSP)
4. Instructions should stress drawing an arrow from the previous group, as opposed to returning to the smallest set each time. (WHP)
5. One teacher introduced this lesson by correcting a mistake found in the student activity sheet. This seems like a good suggestion should teachers or students find mistakes in curriculum materials. (WHP)
6. An appropriate extension for more-able-learners might involve a discussion of how many more objects are in one set than the other. (SHP)

LESSON - 2:56B - One-More and One-Less

Questions

1. What if 1-Less is rolled on the first turn? Do you skip a turn? (WHP)

Problems

1. It was unclear to teachers what to do if 1-Less is rolled on the first move. (WSP, WHP)
2. One teacher commented that we should use the word "die" instead of "dice" since we are using only one. (WSP)

3. In groups of six, not all the students participated. "Leaders" seemed to do the moving for everyone in that group. (WSP) It took a long time for a winner to be established. (WSP, NCD)

Solutions

1. Explain in Teacher's Notes that a six-sided die should be used. A picture of one (all six sides) would be most helpful. (WSP, WHP).
2. Include in rules of the game a specific example of a move (eg. "Suppose you're at 6 ..." or "At the start, suppose you roll 1-Less ..."). (WSP, WHP)
3. If only two or three students played in a group, more practise with skills would be possible and a winner would be established sooner. Also, there would be less chance for students to passively watch the game.
4. Suggest possible ways for the teacher to present the game to the whole class before the students break into groups.
5. Suggest possible extension activities (eg. have the students verbalize what they are doing - "add one, subtract one" - or write a number sentence to record moves). (WHP)

LESSON - 2:56 - D - 1-More and 1-Less

Questions

1. Why start with (the number) 3? (NCD)

Problems

1. Copying the diagram is too complex and consequently takes up most of the lesson time. (WSP, NCD) One teacher alleviated the problem by writing only the answers in the exercise book. (SHP)
2. One teacher had trouble drawing the diagram on the chalkboard. (SHP)
3. One teacher felt the students would be confused by the arrows which represent addition and subtraction of 1. (WHP)

Solutions

1. Simplify the diagram to make it easier to copy (eg. fewer circles set in a straight line). (WHP)
2. If a copying machine is available, reproduce the diagram for the class. (WHP)
3. The teacher should be instructed to draw the diagram on the board before the lesson begins.

4. Label the arrows with 1-More and 1-Less to simplify the instructions. (WHP)
5. The teacher should discuss the meaning of the arrows (1-More and 1-Less) with the class prior to copying diagram.

GRADE FOUR LESSON SUMMARIES

LESSON - 4:144 A - Introduce $\frac{1}{2}$ and $\frac{1}{4}$

Questions

1. What materials should we use; (perhaps) kaukau (since) bananas are too precious? (MP)
2. Could I say, "Work in groups of 2" rather than pairs? (WHP)

Problems

1. Appropriate materials were scarce. Local vegetables and fruits are too valuable and plasticine was unavailable at three sites.
2. The lesson took longer than 30 minutes at all sites (WHP 50 minutes, NCD - three periods).
3. Teachers did not put an equal number of students in each group. (WSP, SHP, NCD)
4. One teacher drew an example of one-third on the chalkboard showing three unequal parts. (WSP) Equality of parts is not stressed. (WSP, SHP)

Solutions

1. Include alternatives in the "Materials Needed" section. If these are not mentioned, shy or insecure teachers may skip the concrete experiences and go directly to worksheet. (MP)
2. Allow more flexibility in scheduling the lesson.
3. Organize into groups of four first, then the students can pair off for the "one-half" activity. Change the lesson sequence to "one-fourth" then "one-half". (NCD)
4. In the instructions to the teacher, stress the importance of equal parts when defining fractions. (WSP, SHP) Have the children verbalize their results after dividing the pieces. (WSP)
5. Include a narrative example in the instructions (eg. "Two children want to buy a meat pie. They only have enough toea for one"). The story gives students a reason for dividing things equally. (NCD) One teacher makes the important observation that when a teacher understands material, the children do better. (SHP)

LESSON - 4:144 B - Introduce $\frac{1}{3}$

Questions

1. Can you divide a circle (into thirds)? (MP)
2. What does it mean, make different plasticine shapes? (WHP)
3. Are these (activity sheet figures) examples (of plasticine shapes)? (WSP)

Problems

1. Both teachers and students had difficulty dividing objects into three equal parts. (MP, WSP, SHP, WHP)
2. Appropriate materials were not readily available. (MP)
3. The lesson took longer than 30 minutes. (MP)

Solutions

1. Include how to divide an object into thirds (eg. "Make sure your object a) has three parts, b) has three equal parts, c) any three equal parts (more than one way to cut). (MP)
2. Provide answers to the dividing-objects exercises (circles, rectangles, etc.) in the Teacher's Notes. (SHP)
3. Introduce the lesson using a rectangle since it is easier to divide into three equal parts.
4. One teacher made the comment that the grade four lessons were the best prepared and most straightforward. (WHP)

LESSON - 4:144 C - Making $\frac{1}{2}$, $\frac{1}{3}$ and $\frac{1}{4}$ of a Whole

Questions

None.

Problems

1. Students continue to have difficulty dividing figures and objects into equal parts. (All)

Solutions

1. Include more examples in the Teacher's Notes using different shapes. (MP)
2. Instead of "Draw lines to show each fraction", the directions should read "Shade in each fraction". (MP, SHP)
3. Suggest that teachers use concrete materials to introduce this review lesson (eg. paper figures). Stress the equality of parts. (NCD)

4. Include an extension activity involving comparisons of fractions (eg. "Would you rather have $\frac{1}{2}$ of a sugar cane or $\frac{1}{3}$? (MP)
5. Stress the need for an evaluation of the lesson and of individual student progress. Perhaps have several students do problems on the board and have the class check the answers. Teachers should consistently check the exercise books as well. (NCD, WHP)
6. Include answers for all exercises in the Teacher's Notes. (SHP)

LESSON - 4:144 D - Recognise $\frac{1}{2}$, $\frac{1}{3}$ and $\frac{1}{4}$ of a Whole

Questions

None.

Problems

1. A general concern was voiced that teachers were not adequately checking students exercise books to see if concepts were being learned. (All)

Solutions

1. The teachers at four sites (WSP, MP, SHP, NCL) engaged in little or no ongoing evaluation whereas the teacher at the fifth site (WHP) religiously observed student work during class time and checked their exercise books frequently. Suggestions to encourage good evaluation practices should be included for each lesson.
2. Recognising Fractions (144 D) was an easier lesson than Making Fractions (144 C). The two lessons should be reversed. (MP, SHP) One school completed both lessons in one period. (WSP)
3. Change the directions from, "Write the fraction" to, "What fraction is shaded in the figure?" (SHP)

LESSON - 4:144 E - Introducing $\frac{1}{2}$ and $\frac{1}{4}$ of a Set

Questions

None.

Problems

1. The teacher does not demonstrate $\frac{1}{4}$ as requested in some problems so the students circle $\frac{1}{2}$ of all groups as in the worked example. (SHP)
2. Students had trouble with one-fourth of twelve (no. 7). (MP, SHP, WHP)

3. One teacher asked many questions during the introduction of the lesson resulting in a number of chorus responses. It was unclear who understood the procedure.
4. The terms "equal piles" and "equal groups", used interchangeably in this lesson caused some confusion. (SHP)
5. Many students had difficulty consistently making equal groups. (All)
6. One teacher implemented 144 E ($\frac{1}{2}$ and $\frac{1}{4}$) and 144 F ($\frac{1}{3}$) as one lesson. (MP) The students did not do as well as those at sites where the lessons were introduced over two periods.

Solutions

1. The Teacher's Notes should stress that each group must have the same amount. (SHP)
2. Circling each group should be stressed and modelled in the worked examples.
3. The Teacher's Notes should suggest introducing the lesson with a whole-group demonstration.
4. The teachers should be encouraged to evaluate student progress by asking individual students to demonstrate understanding.
5. Start with groups of four and pair off later. (NCD)

LESSON - 4:144 F - Introducing $\frac{1}{3}$ of a Set

Questions

None.

Problems

1. Students had trouble making groups with equal amounts. (All)
2. Students circled groups of three. (WSP, SHP, WHP, NCD)

Solutions

1. Demonstration examples should involve 15 or 18 objects, not 9.
2. Students should be instructed to circle and label each group.
3. Provide more practice examples in the Teacher's Notes different from the worked exercises on the activity sheet.
4. Encourage the use of counters by students as they work on their exercises.
5. Stress that teachers should evaluate individual students both orally and by reviewing their exercise books to be sure that the concept is being learned.

LESSON - 4:145 A - Sorting by Two Attributes

Questions

None.

Problems

1. The lesson took longer than expected (WSP - three periods; WHP - rushed lesson; NCD - didn't finish lesson).
2. Most students had trouble sorting because the teachers didn't introduce the lesson clearly. The teachers seemed to have trouble with the language ("and", "or", "not") themselves.
3. Teachers didn't check to see if the sets of Kina Cards were complete. One teacher had to stop the lesson to find missing pieces. (WSP)
4. One teacher was confused whether to use the name of the pictures as labels or the shapes. (SHP)
5. Desk space was a problem at three sites. (WSP, WHP, NCD)

Solutions

1. Divide the lesson into two parts. Do exercises 1 and 2 the first day. Let the children work on numbers 3 and 4 the second day. (WHP)
2. The teacher should work through all the problems before the lesson. Answers for all the exercises should be included in the Teacher's Notes. (MP, WHP)
3. Kina Cards should be organized into envelopes by the teacher or students before the lesson begins. (MP, SHP, WHP)
4. One teacher found working in pairs using small chalkboards to be successful. (MP) Using the floor would also be a good idea. Another teacher found working individually was best because the teacher could observe individual student progress. (SHP)
5. The worked example is not clearly labelled like the exercises on the student activity sheet. (SHP)
6. One teacher, while trying to reduce the amount of teacher talk, felt the lesson failed because he didn't explain the procedures thoroughly enough. (NCD)

LESSON - 4:145 B - Sorting by Two Attributes

Questions

None.

Problems

1. Lesson took longer than expected. (WSP, NCD)
2. Students had difficulty with negation ("not"). (WSP, WHP).
3. The desks were too small for the materials. (All)

Solutions

1. Split the lesson into two parts - a whole-class introduction, followed by small-group exercises.
2. Begin with a review of the previous lesson. (WHP)
3. Two teachers had the students work on the floor. This procedure proved most successful. Students got to travel along "real" roads using actual Kina Cards. One teacher compared this activity with travelling to Mount Hagen and pointed out the importance of reading "city signs". (WHP, MP)
4. Working in groups encourages a game-like atmosphere where students tend to correct each others errors. (SHP, WHP)
5. To be consistent both the outline shape and the picture (or name) should be included in exercises involving Kina Cards. Road signs should begin with a capital letter. (SHP)
6. Background on importance of classification skills should be included in the Teacher's Notes. Teachers often view topics such as geometry, measurement and classification as less important than number operations. The relevance of such topics to the effective development of problem solving, logical thinking and language skills should be pointed out in order to encourage teachers to take such activities seriously.

LESSON - 4:145 C - Sorting by Two Attributes

Questions

None.

Problems

1. One teacher thought the lesson was on map reading. (WSP)
Another felt teachers with less in-service training (than she had) might misunderstand the objective. (MP)
2. The lesson took longer than expected. (SWP - 2 days; NCD - didn't finish)
3. Problem no. 2 is missing a "not" label.
4. Two teachers had trouble interpreting the exercises and asked the observer to explain the problem to the class. (MP, WSP)

5. The students drew the roadways too small to use the Kina Cards effectively. (MP, WSP, SHP, NCD)
6. The teacher felt it took too long for the students to complete the exercises working in groups and taking turns. He had them do the activity individually. (WSP)

Solutions

1. Stress the lesson objectives in a way which shows why this skill is important and how it relates to previous activities.
2. Divide the activity into two lessons - a whole-group introduction followed by small-group exercises.
3. Use arrows to indicate the directions to follow on the roadways. The Teacher's Notes should provide extra examples and solutions to the student problems. (MP)
4. Specifically state in the Teacher's Notes that the pictures are "roadways".
5. Stress the importance of a whole-group demonstration to introduce the activity.
6. Most teachers used the idea of a "rubbish bin" to discard the cards that do not make it to the house. The students need some place to put the unsuccessful cards. (SHP)
7. One teacher was very successful in implementing this lesson by drawing life sized roadways on the floor for the children to walk along. It alleviated the problem of recopying the diagram for each exercise and was very motivating. (WHP)

LESSON - 4:149 C - Introducing Both-Way Rule (Commutative Rule)

Questions

1. Should the students use the activity book? (MP)

Problems

1. The lesson contained too many problems. (All)
2. It took a long time for the students to draw the multiplication blocks. Most sites were not able to complete the activity in one period. (MP, WSP, SHP)
3. One teacher labelled the 2×3 block, 3×2 , confusing the students. (WSP)
4. One teacher called the blocks "squares" (probably confused with "squared paper"). (WSP)

Solutions

1. Split the lesson into two parts or provide four picture exercises and only four symbolic problems. (SHP)
2. Stress the use of the word "block". Have the students paste completed "blocks" into their exercise books to keep.
3. One teacher explained the commutative rule by stating that there are two "stories" for each multiplication problem. (WHP)
4. Allow sufficient time for cutting the blocks.
5. One teacher suggested not including the number labels on the blocks in order to allow the students to discover the array model for multiplication. Also, circles used as answer frames were confused with zero. Use a square or a question mark. (WHP)
6. Encourage the teacher to have the students cut out the multiplication blocks before the class begins (recess, lunch or after school).

LESSON - 4:149 D - Constructing the Multiplication Table

Questions

1. Where will the students start cutting from? (WHP)
2. Does every individual block have to be cut? (SHP)

Problems

1. One teacher could not figure out which blocks were to be cut. He didn't understand the application of the Both-Way rule. (WSP)
2. The lesson took much longer than expected (WSP - three days or six class periods; WHP - two lessons; NCD - three lessons).
3. The students had difficulty applying the Both-Ways rule when cutting out blocks. (All)
4. Students chose blocks to cut out randomly (SHP) and didn't arrange the blocks on the table correctly. (All)
5. Teachers didn't clearly explain goal of lesson. (All)
6. At first the teachers didn't understand the procedure for placing the blocks on the multiplication table. The instructions were unclear about "lifting up the corner" and writing the answer on the table. (SHP, WHP)
7. Students did not work in groups as recommended and could not finish all the cutting. (WSP)
8. The lesson failed across four sites because instructions were too complicated and the teachers were unclear about exactly what to do. (WSP, SHP, WHP, NCD)

Solutions

1. Instruct the teachers to make lists of which blocks each student must cut out. Include a list in Teacher's Notes. (WHP, SHP, NCD)
2. Begin the lesson by demonstrating the Both-Ways rule, using example blocks to show, for example, why 2×3 and 3×2 is the same. No need to cut out both.
3. Divide lesson into two or three - one or two spent cutting out blocks (or outside class) and another one to fill in table.
4. Have students work in groups so that each group makes the blocks for one complete row. One class set of blocks can be constructed and used to "fill in" a class multiplication table. (WHP)
5. Teachers should arrange to construct the blocks prior to the lesson in order to save class time.
6. The Teacher's Notes should list the actual steps of lesson and explain objectives more clearly.
7. One teacher felt the table should be filled in first. Then have the students construct the blocks. This process would clarify the Both-Ways rule. (WHP)
8. On the student worksheet provide a complete example of the multiplication table and the "lifting a corner" graphic as in Teacher's Notes. (SHP)
9. Encourage teachers to do extra preparation for these lessons.

LESSON - 4:164 A - Addition (Revision)

Questions

None.

Problems

1. There were too many exercises for one lesson. (All)
2. Some students accidentally added in the place-value table "label-blocks" when doing the addition problems.
3. Teachers instructions do not describe the addition procedures using base-10 materials as in the grade six Teacher's Notes. (MP)
One teacher did not use the base-10 materials at all. (WSP)
Students at three sites didn't use the base-10 materials after being introduced to them by the teacher. (WSP, SHP, WHP)
4. Students had difficulty writing the answers in the "workspace", then regroup and record the results in the answer space. (WHP)
5. Students made simple mistakes with addition facts. (WHP, SHP, WSP)

Solutions

1. Separate the lesson into two parts: one using base-10 materials only, followed by problems using squared paper. -(MP)
2. To avoid adding in the place-value column labels, draw a picture of a unit and ten-rod above each column rather than using the actual materials.
3. If one lesson involved only the use of the base-10 materials this important step would not be as easily skipped.
4. Include a worked example in the Teacher's Notes. (SHP)
5. Encourage revision of addition facts prior to this lesson.
6. Suggest that the second activity sheet (164 A-2) be given for homework if students are unable to finish in class. (SHP, WHP)

LESSON - 4:164 B - Subtraction (Revision)

Questions

None.

Problems

1. There were too many exercises for one lesson. (All)
2. Instructions do not demonstrate the use of base-10 materials for subtraction as in the grade six Teacher's Notes. (MP)
3. Some students forgot to remove a ten-rod after putting 10 ones in the one's column. (MP)
4. Most students at two sites did not use the base-10 materials. Many appeared not to need them. (SHP, WHP)
5. Some students forgot simple subtraction facts. (WHP)

Solutions

1. Divide the lesson into two or more parts: subtraction using base-10 materials; then a lesson involving simple subtraction followed by another involving subtraction with regrouping.
2. Provide detailed instructions (as in grade six) showing procedures for using the base-10 materials.
3. Suggest a "bank analogy". If you borrow 10 ones from the bank, you must put the same amount (a ten-rod) back. (MP)
4. An introductory lesson should involve using only base-10 materials. Though some children seemed to progress well on work-sheets, doing the problems "the old way" in their heads, the question remains as to whether they can apply their understanding of place-value and regrouping to more difficult problems later. These exercises seemed to be revision for SHP and WHP students.

GRADE SIX LESSON SUMMARIES

LESSON - 6:1 - Counting Systems

Questions

1. Is page one the worksheet for the lesson? (SHP)
2. Why does (the text) say look "above" when picture isn't above, it's on the previous page? (WHP)

Problems

1. At the beginning of the lesson one teacher had the students look only at the table. He didn't mention the picture showing the body-counting system until a student suggested it. (WSP)
2. Some students got their right and left hands mixed up. (WHP)

Solutions

1. Because most teachers follow the step-by-step instructions closely, include two sections: one which lists the objectives and teaching methods and a separate section which lists specific sequenced instructions. (WSP)
2. It would be better to introduce lesson 6:2 (local counting system) first as it relates more directly to the students' world. (WSP)
3. All sites felt it would be better to have the students using their own counting systems as part of this lesson. Instructions should encourage using local counting systems. Include a general section that describes counting in Motu and Pidgin as examples. Perhaps a local villager could be invited to the school to teach the indigenous counting system.
4. Instructions should state the origin of example counting system.
5. Label the left and right hands in the picture.
6. A nice discussion occurred about the standard numeration system, the Roman numeral system and Imbonggu tally number system. Much enthusiasm was generated by this discussion because the teacher was knowledgeable about the local system. (SHP)

LESSON - 6:2 - Counting Systems

Questions

1. What language do the students use the chart in? (SHP)

Problems

1. Two teachers did not have the students work in groups so there was no interaction or class posters. (WSP, NCD)
2. Students were not knowledgeable about their own tok ples counting systems. (SHP, WHP, NCD)
3. Teachers had difficulty with term "meaning" in the third column of the body parts chart. (WSP, WHP, NCD)
4. Students took a long time to draw the table even though the teachers hurried them along. (WHP, NCD)
5. Only one student knew more than one indigenous language. (WSP, SHP)

Solutions

1. Suggest that students go to a village elder and find out about their local counting system. Or better still, invite a villager in for the day who is knowledgeable and willing to supervise and instruct groups. (SHP, WHP)
2. Teachers should be reminded to be patient with their students.
3. Encourage teachers to prepare a chart of his own village's counting system before the lesson. (WHP)
4. Suggest using four columns in body-parts chart. Add "Meaning in tok ples" and "Meaning in English". This seemed to clarify the chart for the students. (WHP)

LESSON - 6:4 - Roman Numerals

Questions

None.

Problems

1. One teacher thought two items of information (no. 6 and no. 7) were questions for the students to answer. (WSP)
2. The students did not know meaning of the word "symbol". (WSP, SHP)
3. "Hindu" is misspelled in the table on page 8.
4. This lesson is too short for older students. (SHP, WHP)
5. Students did not know their own or other counting systems well. (SHP, WHP)
6. The students didn't seem to follow-up when the teacher asked them to speak with their family about the local counting system. (SHP, WHP)

Solutions

1. Include a discussion of Hindu-Arabic symbols at beginning of the lesson along with Roman Numerals.
2. Change the word "symbol" to "sign". (WSP)
3. Provide the opportunity for extension work by leaving space for adding more numbers or add another column labelled "My Own Counting System". (SHP)
4. Instruct the teacher to provide such a chart for students to fill out with family members.
5. Since the teachers seemed to follow the lesson instructions verbatim, include a statement like "Discuss", "Think", or "Talk" when you would like a discussion generated. (WSP)

LESSON - 6:5 - Base-10 Counting

Questions

None.

Problems

1. One teacher had trouble translating pictures of base-10 materials into numbers. (MP)
2. One teacher had trouble with "208" (saying 28). (MP)
3. Base-10 materials were not used. (SHP, MP, WSP)
4. Some students didn't realise ten 10-rods equals one 100-raft. (NCD)
5. Some students had trouble with place-value. (WHP)

Solutions

1. Introducing money (1t, 10t, 1K) would be a useful analogy. (MP)
2. Instructions for the teacher should suggest doing more introductory exercises with "making lots" using only base-10 materials before assigning the problems on p. 11. (WSP)
3. Perhaps the lesson should be split into two: introduce the table and base-10 materials first then assign the exercises the following day.
4. The chart (0-99) is confusing because it resembles a 100-raft. It should include the numbers 1-100 with a discussion of zero in another place.
5. Suggest other whole-group activities to do using the table. (WSP)

6. Set up pictures of base-10 materials in place-value houses to further stress the meanings of ones, tens and hundreds. (WHP)

LESSON - 6:8 - Addition Revision

Questions

1. Do we give students squared paper or do they draw (the tables) in their books? (NCD)

Problems

1. The students did not use squared paper to make the addition table so the lesson took longer than planned.
2. Some students had trouble with the zero column on the addition table. (WHP, SHP)
3. A few students had difficulty knowing where to put the correct answer on the table. (WHP)

Solutions

1. Using squared paper to make tables must be stressed in the Teacher's Notes.
2. Plan a separate lesson on addition with zero prior to the current lesson.
3. Use arrows to show how to place the correct answer on the table.
4. Provide more exercises to extend the lesson. It proved to be quite easy at most sites. (WHP, SHP)
5. This lesson is an example of one which teacher evaluation of the individually completed charts should be stressed. Two sites reported good teacher evaluation procedures (SHP, WHP), while one teacher only put the correct answers on the board. (NCD)

LESSON - 6:10 - Subtraction Revision

Questions

1. What does the heavy line towards the bottom of the subtraction table mean? (SHP)

Problems

1. The most frequent problem encountered involved understanding the significance of the shaded areas in the subtraction table. (All) One teacher thought this was a lesson in memorization. (WSP)
2. The lesson took longer than expected because the table took a long time to draw.

3. It is difficult to see the shading of the lower shaded area. (SHP)
4. One teacher was confused about subtracting using zeros. (WHP)
5. Students had some trouble determining where to put their answers. (WHP)

Solutions

1. Provide the answers in the Teacher's Notes to questions regarding the shaded areas in the table. Interestingly enough, many students found the pattern quite easily. (MP, WHP, NCD)
2. Give explicit instructions as to how to fill in the table. Use arrows to denote where the answers to several examples should be placed. Stress that an introduction of this sort is very important for the class.
3. Stress the need for patience on the part of the teacher while the students copy the chart. Perhaps the table could be made prior to the lesson.
4. One teacher suggested including more subtraction problems as follow-up to provide sufficient practice. (MP)

LESSON - 6:12 - Addition with Regrouping

Questions

None.

Problems

1. One teacher first had the students add $17 + 25$ using all ones with no discussion of place-value. Some students subsequently had difficulty with symbolic regrouping. The teacher seemed reluctant to allow the use of base-10 materials to solve the problems. (WSP)
2. A few students added the tens first. (NCD)

Solutions

1. Have the teacher begin the lesson with a whole-group introduction on the chalkboard. Those sites that introduced the regrouping procedures to the class had no major difficulties. (SHP, WHP, NCD)
2. When using base-10 materials, the number symbols should be recorded inside the place-value table, not along the side. This procedure seemed to afford a smoother transition to numerical problems. (WHP)
3. Demonstrate that using base-10 materials gives the same answer as using symbols. Show both processes by doing the same problem side-by-side.

4. Stress that base-10 materials should be used initially to solve all problems and later to check answers.
5. Teachers should be encouraged to evaluate student progress. (SHP, WHP, NCD)
6. One teacher commented that students in Papua New Guinea are taught to carry the ten to the bottom number, not the top as in the IMP model.
7. Most teachers felt this was an excellent lesson and the base-10 materials were very useful for grade six.

LESSON - 6:13 - Addition With Regrouping

Questions

None.

Problems

1. Some students had difficulty operating with hundreds since no preliminary explanation was offered by the teacher. (WSP)

Solutions

1. An example should be provided in the Teacher's Notes involving regrouping in the 100's place. (WSP, WHP, NCD)
2. All sites stressed the need to provide a whole-class introductory demonstration before beginning individual work. Teacher evaluation of individual student understanding was considered especially important in this lesson, because of the importance of the objective. (WHP)
3. Use different colours of chalk for different place-value houses. (NCD)
4. Stress the relationship between base-10 manipulations and carrying out symbolic work in place-value tables.
5. The exercises in problem 7 should be labelled (a, b, c, d) across the page. (WHP)
6. The base-10 lesson for adding with regrouping seemed to be presented most clearly in the grade six materials. The teachers felt the Teacher's Notes were "straightforward" and seemed enthusiastic about doing addition this way.

LESSON - 6:15 - Addition Palindromes

Questions

1. How do you pronounce "palindromes"? (WHP)

Problems

1. One teacher called 421 and 124 the "same". The students seemed confused. (WSP)
2. One teacher began the adding process with a palindrome (626). The first and last numbers are supposed to be different. (WSP)
3. One teacher saw this activity as having no purpose. (WSP)
4. Several students didn't finish all the problems. (SHP, NCD)

Solutions

1. Provide a pronunciation key for the word "palindrome" in Teacher's Notes.
2. Most sites felt this lesson was straightforward. One teacher suggested moving the exercise involving listing word and number palindromes (7 and 8) to the end of the lesson. (SHP)
3. Emphasize that it sometimes takes more than one step to arrive at a palindrome solution. (WSP)

LESSON - 6:16 - Subtraction With Regrouping

Questions

None.

Problems

1. One teacher seemed unprepared to teach this lesson. He neglected to demonstrate the entire base-10 subtraction procedure. He demonstrated the manipulation as far as changing tens for ones then instructed students to write the answers. When the children showed confusion, the observer was called in to explain. Finally, a student demonstrated the procedure to the class. (WSP)
2. The numbering of the exercises confused the students. Problems are numbered a) and d) on page 38, beginning with b) on page 39.
3. The teacher demonstrated a symbolic addition problem first in order to show the difference between addition and subtraction. The students became confused as to how to do the subtraction problems. (NCD)

Solutions

1. The need for adequate teacher preparation prior to the lesson must be stressed. Clearly most base-10 number operation work needs appropriate teacher in-service.
2. Renumber the exercises across the page.

3. Working through problems with base-10 materials needs more emphasis. Until the teacher recognises the importance of concrete manipulations, symbols will remain in the preferred method since it takes "less" time.
4. One teacher suggests that the place-value "house" should have a "working space" (as in the squared-paper tables) for regrouping. (WHP)
5. Perhaps the subtrahend should be represented using base-10 materials in an area on the right side of the place-value house. Then appropriate ones and tens can be brought down from the minuend (Souviney, Keyser and Sarver, 1978). This model may provide a better analogue for the symbolic algorithm.
6. Suggest that teachers simultaneously explain to the whole class both base-10 materials and symbolic place-value tables. Some sort of convenient display system such as a magnetic display board would be very useful for this purpose.

LESSON - 6:17 - Subtraction With Regrouping

Questions

1. Must the students also write their answers in their exercise books? (SHP)

Problems

1. One teacher does not explain the term "regrouping" to the students. (WSP)
2. Only one example was worked out with the whole class. Many students were confused. (WSP)
3. One teacher had difficulty explaining that the phrase "six from nine" means: $9 - 6$. (WSP)
4. Many students were unable to complete all the problems in the time allowed. (WSP, SHP, WHP)
5. One teacher felt the lesson covered too much material for one lesson (3 and 4 place numbers). (WHP)
6. Students had difficulty copying problems onto squared paper and crossing out the tens during regrouping. (WHP)

Solutions

1. Suggest including more two-place subtraction examples in the whole-group lesson introduction. (WHP)

2. Divide the lesson into two parts: one dealing with "2 houses", another with "3 and 4 houses". Also reduce the number of exercises so the students can finish during class time and the teacher can evaluate their progress.
3. The exercises should be numbered from left to right. (WHP)

LESSON - 6:19 - Subtraction Practice

Questions

1. I am not too sure of the steps (in this lesson). (WHP)

Problems

1. Students attempted to subtract a large number from a smaller one and became confused. (SHP, WHP, WSP)
2. The goal of the lesson wasn't explained well so the students were not motivated to find the "Magic Numbers". (WSP)
3. Many students made careless addition and subtraction mistakes. (WHP)
4. The lesson was not finished since an NBC broadcast interrupted the schedule. It happened frequently at this site. (NCD)

Solutions

1. Directions should stress subtracting the smaller number from the larger after reversing the digits. Include an example (eg. 276) that demonstrates putting the reversed number on top. (SHP, WHP)
2. Squared paper should be used to help with the computation. (SHP, WHP)
3. A whole-class teacher demonstration is very important here. One teacher did three examples, each time giving more responsibility to the students for completing the problems. (WHP)

LESSON - 6:21 - Practising the Multiplication Facts

Questions

1. Do we use one or two dice? (WSP)
2. I have confusion about tomorrow's lesson. Why do the students count to 20? (NCD)
3. How do I start the game off? (NCD)
4. Does the Both-Ways rule apply? (NCD)

Problems

1. One teacher had difficulty organizing the students into groups. (WSP)
2. One teacher had the students use two dice to play the game and did not know what to do with the two numbers on the dice. (WSP)
3. Students mistakenly began by finding multiples of the number on the die on the gameboard. (SHP)
4. The students counted to 20 very quickly in order to prevent the player from writing down any number sentences. (SHP)
5. Students had difficulty moving the counter along the gameboard properly. (WHP)
6. One student wrote the same three number sentences and counted them as separate answers (eg. $16 = 1 \times 16$, 1×16 , 1×16). (WHP)
7. No counter was used. (NCD)

Solutions

1. State clearly in directions that one die and one counter are to be used.
2. Explain why the students are to count to 20 (time keeping) and have them practice counting slowly.
3. Explain why a person who rolls 6 begins the game.
4. Stress the use of the "Both-Ways" rule. This lesson offers an excellent opportunity for both the teacher and the students to practice the concept.
5. A whole-group demonstration should be encouraged in order to show the students how to move counter, take turns, write number sentences, and keep score.
6. The students in general found it extremely hard to do multiplication "backwards" as required in the Multifact game. Perhaps an additional game should be introduced first which involves throwing two dice and multiplying the numbers on top. Each player would then cover the correct answer on the Multifact board with his own counter (perhaps bottle tops with the player's initial written on them). The player with the most squares covered after 10 minutes play wins.

LESSON - 6:22 - Multiplication Revision

Questions

None.

Problems

1. One teacher said he found the matrix multiplication model difficult. (WSP) Two teachers mentioned that the in-service held in Port Moresby helped them to understand the multiplication procedures using base-10 materials. (SHP, NCD)
2. Base-10 materials were not used due to time constraints. (WSP)
3. The students did not finish all problems. (WSP, NCD)
4. The teachers and students were confused by reference to "rectangle shapes" in the instructions. (SHP)
5. Some students added the blocks at the top of the matrix (multiplication) in their final answer. (WHP)
6. One teacher instructed the students to use base-10 materials to help them solve their problems, however only about half did so. (NCD)

Solutions

1. Teacher effectiveness in these types of lessons depends primarily on their facility in using the materials. The teachers refer back to the Port Moresby in-service course often.
2. One teacher told ~~the~~ students not to work out the problems until they had used the base-10 materials first. This would be a useful suggestion to include in the Teacher's Notes for all lessons which require base-10 materials (eg. "Don't forget to use blocks first!"). (WHP)
3. To reduce the problem of the students adding the second factor (the number ~~across~~ the-top) to the final answer (the array inside) leave more space between the base-10 materials and the horizontal line or draw pictures of the two factors instead of using actual base-10 materials.

CONCLUSION

Based on the 39 lesson summaries the following conclusions and recommendations are offered. The results are reported in two categories:

1. Classroom management
2. Instructional materials

Effective instruction depends to a great extent on how thoroughly the teacher understands the complex relationship between the subject matter concepts, the instructional methodology and the curriculum materials.

Consequently, it is of primary importance for teachers to work through lessons prior to classroom implementation. Procedures associated with implementing difficult lessons, such as sorting attributes, should be well understood by the teacher before instruction with students commences. The actual manipulation of attribute materials by the teacher as part of their lesson planning will help them anticipate problems the students are likely to encounter and plan their lesson introduction accordingly. Any preliminary in-service training should focus on actually working through the lessons as opposed to a general discussion of teaching methodology and instructional materials.

Classroom Management

Materials Management: In general the teachers in this study exhibited a reasonable grasp of the content and methodology. Problems occurred initially however with the organization, management and storage of the curriculum materials. After initial frustrations and delays it was decided that materials such as base-10 blocks, Kina Cards, squared paper and workbooks should be located at the front of the classroom within easy access of both teachers and students. Large manila envelopes served as storage containers for paper materials. Plastic bags or containers would help preserve the degradable items. When storing base-10 blocks, separate containers for each student's set of 1's, 10's and 100's helps ensure that a complete classroom set is available for easy distribution.

In order to reduce the amount of set-up time required, student monitors were effectively utilized to distribute materials. Such a procedure should be recommended in the Teacher's Notes or future curriculum guides. If materials are stored properly and student helpers are responsible for distributing them, more time can be spent on actual lesson activities.

Activity Book: Having access to student activity books seemed fundamental to the success of the trial lessons. Those lessons taught without them often caused confusion. Direct access to activity books allowed students to follow along with the teacher's instructions enabling them to understand lesson objectives and procedures more readily.

Teachers found it helpful to be able to refer to specific pictures or diagrams when explaining difficult concepts. At some sites the booklets were stored in the students desks, at others student monitors distributed them at the beginning of the lesson.

Lesson Organization: In general, successful lessons began with a whole-group demonstration. Such lesson introduction seemed necessary to ensure that the students understood critical procedures prior to breaking up into small groups. This simple technique helped minimize the problem of having to reassemble the whole class in order to clarify basic procedural questions once small groups were working independently.

The organization of small groups initially proved to be difficult for some teachers. Prior to their involvement with the current project, these teachers normally conducted whole-class lessons followed by students completing exercises on an independent basis. The suggested procedure of breaking into four or five groups for half the period or more was not carried out easily.

Suggestions should be made in the Teacher's Notes to help teachers organize groups quickly and efficiently. Successful ways to group students include assigning numbers, drawing cards or choosing sticks. Once this task is accomplished, students are able to quickly begin cooperative group activities. The teacher then moves from group to group answering questions, motivating students and assessing progress. Frequently it is useful to assemble the group at the end of the period to review the day's activities and plan for the next lesson.

Classroom Atmosphere: The teacher plays a prominent role in establishing a positive, relaxed environment in which to learn. In some cases during the trial lessons the teachers were not sensitive to the children's abilities. Particularly when the instructions required children to copy graphics or prepare required manipulative aids.

Occasionally a lesson was not completed because teachers became angry when students were taking too long to prepare the materials. In some cases (particularly in grade two) the tasks were clearly too difficult and time consuming for children of this age. Instead of altering the

lesson plan the teachers became cross with the students and themselves. The teachers should not be held totally accountable, however, since one objective of the trialling study was to assess the feasibility of including various types of activities in future curriculum materials. We therefore expected children to experience difficulty with certain lessons.

A word to the teacher about the art of patience and acceptance of student abilities would have been justified here. Though the teacher and student made an impressive effort to construct even the more complicated materials, they all eventually used their better judgement and moved to the next lesson when it was clear that little progress was being made.

Evaluating Student Progress: Finally, with few exceptions, teachers rarely assessed individual student progress on lesson objectives. Appropriate evaluation techniques should be described in the Teacher's Notes to ensure teachers have the means of assessing individual achievement and subsequently make effective instructional decisions. Individuals should be observed during the activity phase of the lesson and exercise books should be carefully checked to be certain students are completing work accurately. Reviewing exercises with the whole class on the chalkboard and evaluating chorused responses is not sufficient to make instructional decisions for even the majority of the class. Careful observation of individual students working in groups, checking exercise books frequently, giving brief tests every week or two and keeping accurate records will go far in improving the teacher's ability to effectively evaluate student progress.

Instructional Materials

Teacher's Notes: Instructions and teaching suggestions should be kept simple and explicit. All pictures used on student activity sheets need to be referenced in the Teacher's Notes. For example, if a hand holding a pencil is displayed on the activity sheet, it should be stated that the picture is there to remind students to use a pencil to write answers in their exercise books. If a picture depicts a student using a measuring device, then it needs to be clearly stated that

students are supposed to do the same activity as the child in the picture. The writer should not assume that the teacher will inform the students regarding the significance of the pictures simply because they are displayed.

Background Notes: The rational for teaching each lesson should be clearly stated at the beginning of each topical series. Include the ultimate goal of the sequence of lessons (eg. length-comparison activities are the first step in developing measurement skills using centimetres and metres). Also list previous skills and concepts which are necessary to effectively carry out the series of activities (eg. students must know how to count to 100, exchange ones and tens and write numbers smaller than 100 in place-value tables before they begin this series of lessons on two-place addition).

If the rational is not clearly stated, lessons become isolated events and are seen by teacher (and students) as having no real purpose other than perhaps being fun for students. Teachers at times had difficulty seeing reasons for teaching certain lessons in the trial curriculum.

Lesson Introduction: Sample introductions for each lesson should be included. Teachers who were able to devise their own lesson openings had less difficulty implementing the entire lesson. Providing suggestions for introducing the lessons might help the teacher who lacks experience or confidence get off to a better start. For example, when the lesson calls for the students to play a game, a clear explanation of the objective and rules of the game should be suggested in the Teacher's Notes.

Answers: In using these materials, teachers needed confirmation that the answers they reach to problems presented in the lessons are in fact the correct ones. Consequently, all answers to the worksheet exercises and questions presented in the Teacher's Notes should be provided. This gives assurance to teachers who lack confidence and consequently reduces the likelihood that the lesson will be skipped.

Alternative Materials: Often, teachers need access to alternative instructional materials and aids since suggested items are frequently

unavailable. Wherever possible the lessons should utilize locally produced materials. Even when centrally produced aids are considered preferable (eg. base-10 materials) locally produced alternatives should be listed in a separate section (eg. seed canoes and rafts or squared-paper models).

Such suggestions will ensure that students actually engage in recommended manipulative activities and not skip directly to the symbolic exercises due to the lack of appropriate concrete models. The Teacher's Notes should provide every possible aid to the teacher to ensure that this important concept development stage of the mathematics program is fully implemented.

Review Lessons: To further ensure that skills are being learned and mastered, it would be useful to periodically include a review lesson. A brief assessment test could be administered after these revision exercises to aid teachers in monitoring student abilities and achievement. These tests would also provide a basis for developing and maintaining an accurate record of the pupil's progress.

Teacher In-service: Probably the most important observation made during the implementation of these trial materials involved the preliminary training of the teachers themselves. An important and, in our opinion, vital element associated with the IMP sponsored in-service course held in April 1980 was that the teachers directly experienced the use of the recommended aids in a learning environment similar to that in their own classrooms.

Throughout the study teachers referred back to the Port Moresby In-service during their interviews with the observers. They felt that the new instructional techniques, such as those involving base-10 materials, became clear during the "hands on" approach used throughout the workshops. Similar workshops have subsequently been planned and carried out by project teachers in their own area based on the IMP prototype. In-service experiences of two weeks duration or less can be extremely effective if based on a specific curriculum material that is to be subsequently implemented in the participants' classrooms.

In-service courses that attempt to broaden participants general background relative to instructional methodology or subject matter competence will have far less impact on teachers classroom behaviours given a fixed amount of resources and time. Based on our experience, an in-service course designed to assist with the implementation of a specific curriculum product is more effective. Opportunities should be provided for teachers to construct pertinent learning aids to take back to their classrooms. Using the actual instructional materials and aids in a simulated classroom environment should have a considerable effect on teacher classroom behaviours and subsequent student performance.

Appropriate teacher guides and in-service training helped five teachers plan their mathematics lessons more effectively. The availability of student activity books and learning aids helped teachers communicate key mathematics concepts and helped children develop those concepts into practical arithmetic and measurement skills. With less than two weeks in-service training and occasional advice from an on-site observer, the teachers were quite successful overall in co-ordinating various instructional components and constructing reasonably effective lessons.

Recommendations

1. That student textbooks be developed and distributed to all community schools.
2. That a minimal set of learning aids be produced centrally and distributed to all community schools.
3. That an appropriately detailed teacher's guide be provided.
4. That an in-service training program be developed on a regional and/or school basis to specifically implement the program.

BIBLIOGRAPHY

Gearhart, M. "Divanap Community School Field Report", Indigenous Mathematics Project Working Paper Series, Department of Education, Papua New Guinea, No. 8, 1980.

Johnson, K. "Kero Community School Field Report", Indigenous Mathematics Project Working Paper Series, Department of Education, Papua New Guinea, No.9, 1980.

Levin, P. "Andra Community School Field Report", Indigenous Mathematics Project Working Paper Series, Department of Education, Papua New Guinea, No. 6, 1980.

Lineberger, J. "Ororo Community School Field Report", Indigenous Mathematics Project Working Paper Series, Department of Education, Papua New Guinea, No. 7, 1980.

Rowe, R, "Muglamp Community School Field Report", Indigenous Mathematics Project Working Paper Series, Department of Education, Papua New Guinea, No. 10, 1980.

Souviney, R., T. Keyser and A. Sarver, Mathmatters. Goodyear Publishing Company, Santa Monica: California, 1978.

Lesson: _____

Objective: _____

<u>Teacher:</u>	MP	WSP	SHP	WHP	NCD
Pre-interview Questions					
Debriefing Suggestions					
<u>Implementation:</u>					
Materials					
Management					
Time					

INDIGENOUS MATHEMATICS PROJECT

WORKING PAPER SERIES

1. Learning to Compute.
R. Souviney, January 1980.
2. Strategies for Mathematical Problem Solving.
R. Souviney, March 1980.
3. Assessment Administration Guide.
R. Souviney, April 1980.
4. Field Guide for Studying Classroom Events and Their Cultural Context.
P. Levin, M. Gearhart and R. Souviney, June 1980.
5. International Congress on Mathematics Education.
R. Souviney, V. Kada and D. Malaga; D. Lancy; M. Britt; B. Roberts, August 1980.
6. Andra Community School Field Report.
P. Levin, November 1980.
7. Ororo Community School Field Report.
J. Lineberger, November 1980.
8. Divanap Community School Field Report.
M. Gearhart, November 1980.
9. Kero Community School Field Report.
K. Johnson, November 1980.
10. Muglamp Community School Field Report.
B. Rowe, November 1980.
11. Teachers Notes and Student Worksheets — Grade 2. 1980.
12. Teachers Notes and Student Worksheets — Grade 4. 1980.
13. Teachers and Students Text — Grade 6. 1980.
14. The Changing Form of Numerical Reasoning Among the Oksapmin.
G. Saxe, January 1981.
15. Intra-Cultural Variation in Cognitive Development — Conservation of Length
Among the Imbonggu.
D. Lancy, R. Souviney, V. Kada, February 1981.
16. The Education of Atawe.
M. Clements and P. Jones, March 1981.
17. Influences on Mathematical Learning in Papua New Guinea — Some Crosscultural
Perspectives.
M. Clements and G. Lean, May 1981.
18. Teaching Community School Mathematics — A Comparison of Five Sites.
B. Miller-Souviney, June 1981.
19. Classroom Maths Games.
IMP Staff, June 1981.
20. Teaching and Learning Mathematics in the Community Schools of Papua New
Guinea.
R. Souviney, July 1981.